Decision Rationale

**Total Maximum Daily Load for
Fecal Coliform for Naked Creek**

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety, that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the TMDL for fecal coliform for Naked Creek. EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

1)   The TMDL is designed to implement applicable water quality standards.
2)   The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.
3)   The TMDL considers the impacts of background pollutant contributions.
4)   The TMDL considers critical environmental conditions.
5)   The TMDL considers seasonal environmental variations.
6)   The TMDL includes a margin of safety.
7)   There is reasonable assurance that the TMDL can be met.
8)   The TMDL has been subject to public participation.

II. Background

The 14,600 acre Naked Creek watershed is located in Augusta and Rockingham Counties. The TMDL addresses the full 6.75 mile stream segment, from its headwaters to its confluence with the North River. Agricultural lands and forests make up roughly 99% of the 14,600 acre watershed.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed 6.75 miles of Naked Creek as being impaired by elevated levels of fecal coliform on Virginia's 1998 Section 303(d) list. Naked Creek was listed for violations of Virginia's fecal coliform bacteria water quality standard. Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of all

warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA has been encouraging the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation has been drawn between the concentrations of e-coli and enterococci, and the incidence of gastrointestinal illness. The Commonwealth plans on adopting the e-coli and enterococci standards in 2002.

As Virginia designates all of its waters for primary contact, all waters must meet the current fecal coliform standard for primary contact. Virginia's standard applies to all streams designated as primary contact for all flows. Through the development of this and other similar TMDLs, it was discovered that natural conditions (wildlife contributions to the streams) could cause or contribute to violations of the fecal coliform standard. Thus, many of Virginia's TMDLs have called for some reduction in the amount of wildlife contributions to the affected streams. EPA believes that a significant reduction in wildlife is not practical and will not be necessary due to the implementation plan discussed below.

A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. The first phase of the implementation will reduce all sources of fecal coliform to the stream other than wildlife. In Phase 2, which can occur concurrently to Phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. The Commonwealth has indicated that, during Phase 2 it will evaluate the following items in relation to the standard. 1) The Commonwealth may develop a Use Attainability Analysis (UAA) for streams with wildlife reductions which are not used for frequent bathing. Depending upon the result of the UAA, it is possible that these streams could be designated as primary contact for infrequent bathing. 2) The Commonwealth will also investigate incorporating a natural background condition for the bacteriological indicator.

After the completion of Phase 1 of the implementation plan, the Commonwealth will monitor the stream to determine if the wildlife reductions are actually necessary, as the violation level associated with the wildlife loading may be smaller than the percent error of the model or the Margin of Safety. In Phase 3, the Commonwealth will investigate the sampling data to determine if further load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of Phases 1 and 2, further work and reductions will be warranted.

Naked Creek identified as watershed VAV-B28R, was given a high priority for TMDL development. Section 303(d) of the CWA and its implementing regulations require a TMDL to be

developed for those waterbodies identified as impaired by the state where technology-based and other controls do not provide for the attainment of water quality standards. The TMDL submitted by Virginia is designed to determine the acceptable load of fecal coliform which can be delivered to Naked Creek, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality standard is attained and maintained. HSPF is considered an appropriate model to analyze this watershed because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources, the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.[2] Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. These wastes do not need a transport mechanism to allow them to reach the stream. The allocation plan calls for the reduction in fecal coliform wastes delivered by cattle in-stream, wildlife in-stream, straight pipes, and specific land uses.

Table 1 - Summarizes the Specific Elements of the TMDL.

Segment	Parameter	TMDL	WLA (cfu/yr)	LA (cfu/yr)	MOS (cfu/yr) [1]
Total	Fecal Coliform	2,822E+12	0.006E+12	2,681E+12	141E+12

1 Virginia includes an explicit MOS by identifying the TMDL target as achieving the total fecal coliform water quality concentration of 190 cfu/100ml as opposed to the WQS of 200 cfu/ml. This can be viewed explicitly as a 5% MOS.

EPA believes it is important to recognize the conceptual difference among the waste load allocation (WLA) values, load allocation (LA) values for sources modeled as direct deposition to stream segments, and LA values for flux sources of fecal coliform to land use categories. The WLA values and LA values for direct sources represent amounts of fecal coliform which are actually deposited into the stream segments. The HSPF model, which considers landscape processes which affect fecal coliform runoff from land uses, determines the amount of fecal coliform which reaches the stream segments. The LA in Table 1 is the amount of colony forming units (cfu) reaching the stream

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[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

[2]CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

from nonpoint sources annually.

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a fecal coliform TMDL for Naked Creek. EPA is therefore approving this TMDL. Our approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (both wet weather and directly deposited nonpoint sources) have caused violations of the water quality standards and designated uses on Naked Creek. The water quality criterion for fecal coliform is a geometric mean 200 cfu/100mL or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30 day period are required for the geometric mean standard. Since the state rarely collects more than one sample over a thirty-day period, most of the samples are measured against the instantaneous standard.

The HSPF model is being used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from point and other direct deposit sources necessary to support the fecal coliform water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform to Naked Creek will ensure that the criterion is attained.

The TMDL modelers determine the fecal coliform production rates within the watershed. Data used in the model is obtained from a wide array of sources, including farm practices in the area, the amount and concentration of farm animals, point sources in the watershed, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, land uses, weather, stream geometry, etc.. The model then combines all the data to determine the hydrology and water quality of the stream.

A "paired watershed" approach was used in the hydrology calibration for Naked Creek. A "paired watershed" approach was used because there was insufficient hydrology data on Naked Creek. In a "paired watershed" approach, the modelers model the hydrology of a stream with a long term hydrologic record (Linville Creek) that would have a response similar to the watershed being studied (Naked Creek).

Linville Creek, which is approximately ten miles from Naked Creek was the "paired watershed". The calibrated and validated Linville Creek hydrology model was adjusted to account for differences between the watersheds. United States Geological Survey Station Number 01632082 is

located on Linville Creek in Broadway, Virginia.   Weather and stream flow data were available from August of 1985 to September of 1998 The calibration was run using the data from September 01, 1991 to January 18, 1996. This five-year period had both wet and dry weather conditions. The model simulated the observed conditions quite well.

A validation run was conducted to see how well the model simulated observed data over a different time period from Linville Creek. This was conducted to insure that the model could simulate different conditions in the creek. The validation used data from September of 1986 through August of 1990. The simulated data from the validation compared favorably to the observed conditions as well.

EPA believes that using HSPF to model and allocate fecal coliform will ensure that the designated uses and water quality standards will be attained and maintained for Naked Creek.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading of fecal coliform is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest, cropland, pasture 1, pasture 2, high density residential, low density residential, and farmstead), directly deposited nonpoint sources of fecal coliform (cattle in-stream, wildlife in-stream, and straight pipes), and point sources. Activities such as the application of manure, fertilizer, and the direct deposition of wastes from grazing animals are considered fluxes to the land use categories. The actual value for the total fecal load can be found in Table 1 of this document. The total allowable load is calculated on an annual basis due to the nature of HSPF model.

Waste Load Allocations

Virginia has stated that there are three point sources discharging to Naked Creek, two of which are permitted to discharge fecal coliform. The two permitted point sources are single family residential sewage treatment facilities. The single family residential sewage treatment plants are covered by Virginia general permit VAG40. These facilities are allowed to discharge 1,000 gallons per day with a fecal coliform concentration of 200 cfu/100 mL. Therefore, these facilities were given a WLA of 2.76E+9. Their WLA was determined by multiplying their allowable concentration (200 cfu/100 mL) by their permitted flow of 1,000 gallons per day (3,790,000 ml/day) by the number of days in a year (365).

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative

water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table 2 - Waste Load Allocations for Naked Creek

Facility	Permit Number	Existing Load	Allocated Load
Single Family Unit	VAG401541	2.76E+09	2.76E+09
Single Family Unit	VAG401958	2.76E+09	2.76E+09
Total	N/A	5.52E+09	5.52E+09

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the HSPF model to represent the Naked Creek watershed. The HSPF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint loadings, and receiving water quality for conventional pollutants and toxicants[3]. HSPF uses precipitation data for continuous and storm event simulation to determine total fecal loading to Naked Creek from forest, cropland, low density residential, high density residential, pasture 1, pasture 2, and farmstead lands. The total land loading of fecal coliform is the result of the application of manure and biosolids, direct deposition from cattle, other livestock and wildlife (geese, deer, etc.), the deposition of fecal coliform from failed septic systems, the application of poultry litter, and fecal coliform production from pets.

In addition, VADEQ recognizes the significant loading of fecal coliform from cattle in-stream, straight pipes, and wildlife in-stream. These sources are not dependent on a transport mechanism to reach a surface waterbody, and therefore, can impact water quality during low and high flow events.

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[3] Supra, footnote 2.

Table 3 - LA for the Land Application of Fecal Coliform

Source	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Forest	1.5E+12	1.5E+12	0%
Cropland	24.4E+12	17.1E+12	30%
Residential [a]	31.7E+12	22.2E+12 [b]	30%
Pasture 1	1,976E+12	1,383E+12	30%
Pasture 2	1,795E+12	1,256E+12	30%
Straight Pipes	0.6E+12	0.0	100%
Wildlife In-Stream	1.2E+12	0.84E+12	30%
Cattle In-Stream	31.3E+12	0.0	100%

a Includes loading from low density residential, high density residential, and farmstead.
b Reductions do not apply to high density residential because their loadings deemed negligible

3) The TMDL considers the impacts of background pollution.

A background concentration was set by determining the wildlife loading to each land segment.

4) The TMDL considers critical environmental conditions.

According to the EPA regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Naked Creek is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[4]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a

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[4]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

minimum. These critical conditions ensure that water quality standards will be met for other than worst case scenarios.

The sources of bacteria for these stream segments were a mixture of dry and wet weather driven sources. Therefore, the critical condition for Naked Creek was represented as a typical hydrologic year. Since the stream was modeled to attain the geometric mean standard and base

and low flow events occurred far more often then wet weather events, it was essential that the standard be maintained during these periods. Therefore, base flow conditions were the more critical period.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis effectively considered seasonal environmental variations. The model also accounted for the seasonal variation in loading. Fecal coliform loads changed for many of the sources depending on the time of the year. For example, cattle spent more time in the stream in the summer and animals were confined for longer periods of time in the winter.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The margin of safety (MOS) may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL.

Virginia includes an explicit margin of safety by establishing the TMDL target water quality concentration for fecal coliform at 190 cfu/ 100mL, which is more stringent than Virginia's water quality standard of 200 cfu/100 mL. This would be considered an explicit 5% margin of safety.

7) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program. Additionally, Virginia's Unified Watershed Assessment, an element of the Clean Water Action Plan, could provide assistance in implementing this TMDL.

The TMDL in its current form is designed to meet the applicable water quality standards. However, due to the wildlife issue that was previously mentioned, the Commonwealth believes that it may be appropriate to modify its current standards to address the problems associated with wildlife loadings. It is believed that because of the violation rate associated with the wildlife loadings and/or because of any modifications that may have been made, that Phase 1 of the implementation process will allow Naked Creek to attain standards. The Commonwealth is investigating possibly changing the use of these waters or having a natural condition amendment added to their standards.

8) The TMDLs have been subject to public participation.

Two public meetings were held to discuss TMDL development on Naked Creek. All of the public meetings were public noticed in the *Virginia Register* and opened to at least a thirty-day comment period. The first meeting was held on October 25, 2001 in Weyers Cave, VA. Twenty-five people attended this initial meeting on the TMDL. Around forty-five people attended the second meeting which was held in Fort Defiance, VA on February 28, 2002. The second public meeting presented the draft TMDL report. Two comments were received electronically after the second public meeting.